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Improving the thermal insulation properties of concrete by adding high density polystyrene

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Abstract— **This research aims to understand the changes associated with the incorporation of polystyrene into the concrete mixture, such as the change in density, compressive strength, and thermal conductivity, and comparing it with other normal concrete.**

Keywords— **Polystyrene; Ordinary concrete; Thermal insulation; Replacement; Concrete mix.**

I. INTRODUCTION

This technology is the course of growth and development, and every day new inventions appear to develop the means used in construction work, and one of the most prominent materials subject to experimentation and use is the polystyrene product, as it is considered a heat and sound insulating material and has the property of light weight and pressure bearing due to the air contained in the material inside it.

Initial basic materials such as cement, fine aggregate, water, polystyrene and chemical additives were used to implement concrete mixtures, and each material will be presented separately.

Thermal insulation in facilities and buildings is designed on the basis of containing the heat inside the building in winter and preventing the entry of heat in summer.

The amount of heat that penetrates the walls and ceilings in summer days is estimated at very high rates.

The thermal conductivity of structural elements depends on several factors, including the properties of the material or materials from which it is composed Including elements, their thickness and exposure of their surfaces to weathering are known to increase the transition value thermal (decrease in the value of thermal resistance) means an increase in the ability of the element to transfer heat and then an increase .

In the amount of internal heat lost in winter and gained in summer, which results in an increase in energy consumption necessary for heating in winter and cooling in summer.

Accordingly, it is always preferred that the external elements of buildings have low thermal transition (high thermal resistance).

II. METHODOLOGY FOLLOWED

This study is based on the experiments included in the practical side and the research knowledge of who determines the behaviours of the mixture, and proves the possibility of using this mixture as an alternative to ordinary concrete, and studies the change that occurs to concrete when conducting tests of pressure, operational resistance, density, absorption, thermal conductivity and reduction rates .

It provides outputs that summarize the way in which the concept of substitution works, replacing materials with other materials, reducing the depletion of natural resources, and the impact of this change to meet the requirements of construction, ease of handling, and achieving the principle of sustainability by keeping pace with industrial progress.

Where the value of replacing polystyrene was in fixed proportions, it was chosen to serve specific goals in the natural conditions of the laboratory to simulate the results with outputs close to the reality and the local climate of the city of Tripoli, Libya.

The hypothesis is that it is possible to improve the level of thermal comfort within residential spaces and reduce energy consumption for cooling and heating, through the comparison between the types and sectors of the thermal insulation material using equations that calculate the insulation values.

It is possible to reduce the dead loads of concrete and facilitate handling, as well as obtaining compressive strength within the permissible limit of loading.

III. MATERIALS

The cement used for the concrete was Ordinary Portland Cement, classified as 52.5 N CEM Class 1 according to BS EN 197-1. Polystyrene was used with a density of 35 kg / m 3 and (Fig. 1) shows the polystyrene used, natural sand with a specific gravity of 2.66 was used, SIKA TEMPO 12 superplasticizer was used, and water was used according to the specifications of drinking water.

Fig. 1 Polystyrene granules, whose density is 35 kg / m3

IV. RESULTS

Replacing coarse aggregates with polystyrene has been shown to increase the heat resistance of concrete. Where the

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thermal conductivity value of 0.098 W/mC was deduced from (Fig. 2), and (Table 1) shows the results of thermal conductivity at different depths in the sample.

And it is considered a good indicator of thermal insulator compared to ordinary concrete, and the addition of polystyrene reduces the density of concrete, as it was 1230 kg / cubic meter, which is approximately 53% less than ordinary concrete, and the result of compressive strength after 28 days was 7.33MPa .

TABLE I
THERMAL CONDUCTIVITY RESULTS AT DIFFERENT DEPTHS

W/C	Polystyrene %	Sample drilling depth (m)	Projected temperature (c°)	Temperature at each depth (c°)	Thermal conductivity W/m.C
0.45	100	3	42	26.1	0.098
		6		28.4	
		12		40.7	

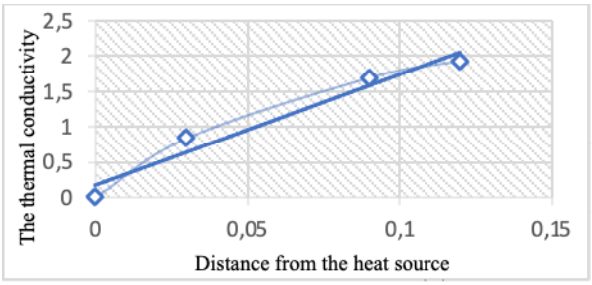

Fig. 2 Calculate the average thermal conductivity

Fig. 3 The result of the weight of a cube size (15 * 15 * 15 cm)

V. Conclusions

The value of thermal conductivity is a good heat insulator compared to ordinary concrete, and a thermal reduction of 78% was obtained from the value of thermal conductivity.

And the use of this concrete saves a great deal in energy consumption .

The addition of polystyrene to concrete reduces its weight so that it is easier to transport and handle, and (Figure 3) shows the results of weighing a cube of size (15*15*15 cm).Concrete with a compressive strength of 7.33 MPa is classified as M7.5 grade concrete.

Where it can be used in insulating bricks as an example .

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